Information content analysis of aerosol layer height from multi-angle polarized measurements in oxygen A and B bands

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Aerosol vertical distribution is one of the essential factors that influences the atmospheric radiative energy budget, cloud physics, and surface air quality. Because photons scattered by high-altitude aerosol layers travel a shorter path through the atmosphere than those scattered by low-altitude aerosols, they are less affected by O_2 absorption and as a consequence, many attempts have been made to retrieve aerosol layer height (ALH) from satellite observations in O_2 absorption bands. Examples include SCIAMACHY [1,2], GOME/GOME-2 [3], and EPIC on DSCOVR [4,5]. Building upon our earlier study about the sensitivity of polarized measurements in the O_2 A band to ALH [6], we analyze the capability and improvement of ALH retrieval when adding polarized measurements acquired at multiple view angles. The sensitivity of simulated radiances from our UNified and Linearized Vector Radiative Transfer Model [7] (https://unl-vrtm.org) to ALH at different viewing geometries are compared. After estimating the degree of freedom for signal (DFS), we find that more information regarding ALH can be obtained from multi-angle measurements than that from single-angle measurements. In this presentation, we will describe the contribution of multi-angle polarized measurements to ALH retrieval and quantify the improvement of ALH information along with the posterior error, as well as the comparison of polarized and unpolarized observations. We focus the analysis on the Multi-Angle Imager for Aerosols (MAIA) instrument, currently being built for launch in 2022, which will acquire multi-angle (unpolarized) O_2 A-band measurements, as well as on other near-future sensors that may have polarization capabilities in this band.

References

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